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(71) Applicant(s)
Hawke Cable Glands Limited
(Incorporated in the United Kingdom)
Leighswood Road, Aldridge, WALSALL,
West Midlands, OL7 ONA, United Kingdom

(72) Inventor(s)
Trevor William Norris

(74) Agent and/or Address for Service
Barker Brettell
138 Hagley Road, Edgbaston, BIRMINGHAM,
B16 9PW, United Kingdom

(54) Abstract Title
Connector with axially compressed resilient seal

(57) An electrical connector comprises a plug 1 arranged for push-fit connection to a socket 5 to engage a plurality of plug contacts 2 with mating socket contacts 6. The plug contacts 2 are connected to individual conductor cores 3 of a cable by solder joints 4 isolated from each other in respective bores 10a of a multi-bore seal 10. The seal 10 is axially compressed to provide a water block seal around the joints by a compression plate 11 arranged to be urged axially by threaded engagement of a compression nut 13 with a plug body 7 with axial displacement of the plate 11 being limited to control compression of the seal 10.

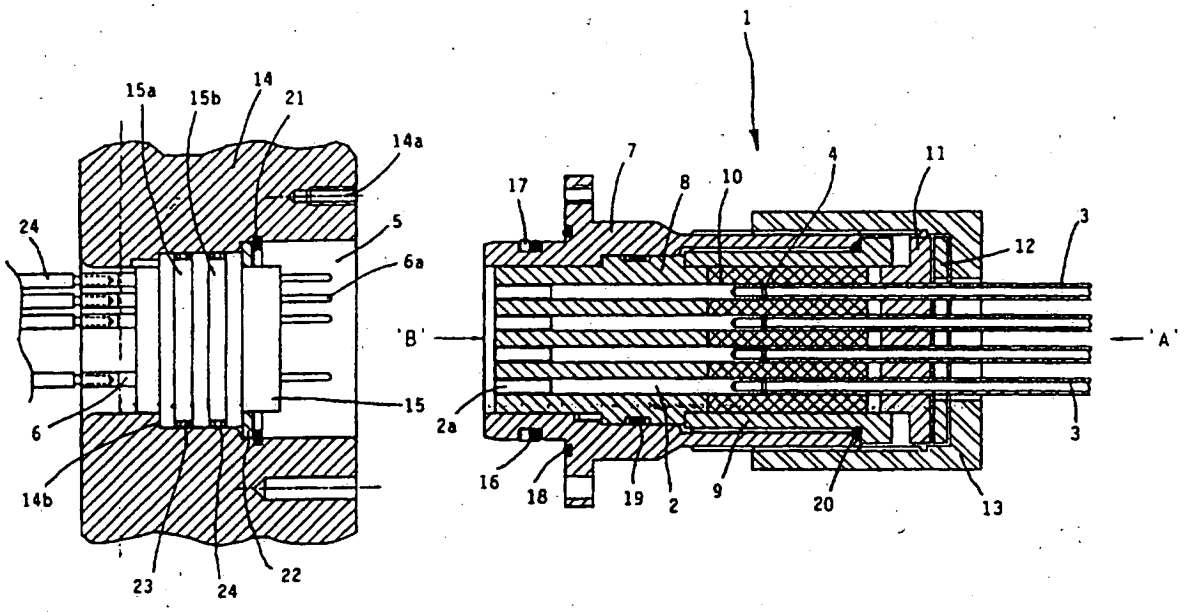

FIGURE 1.

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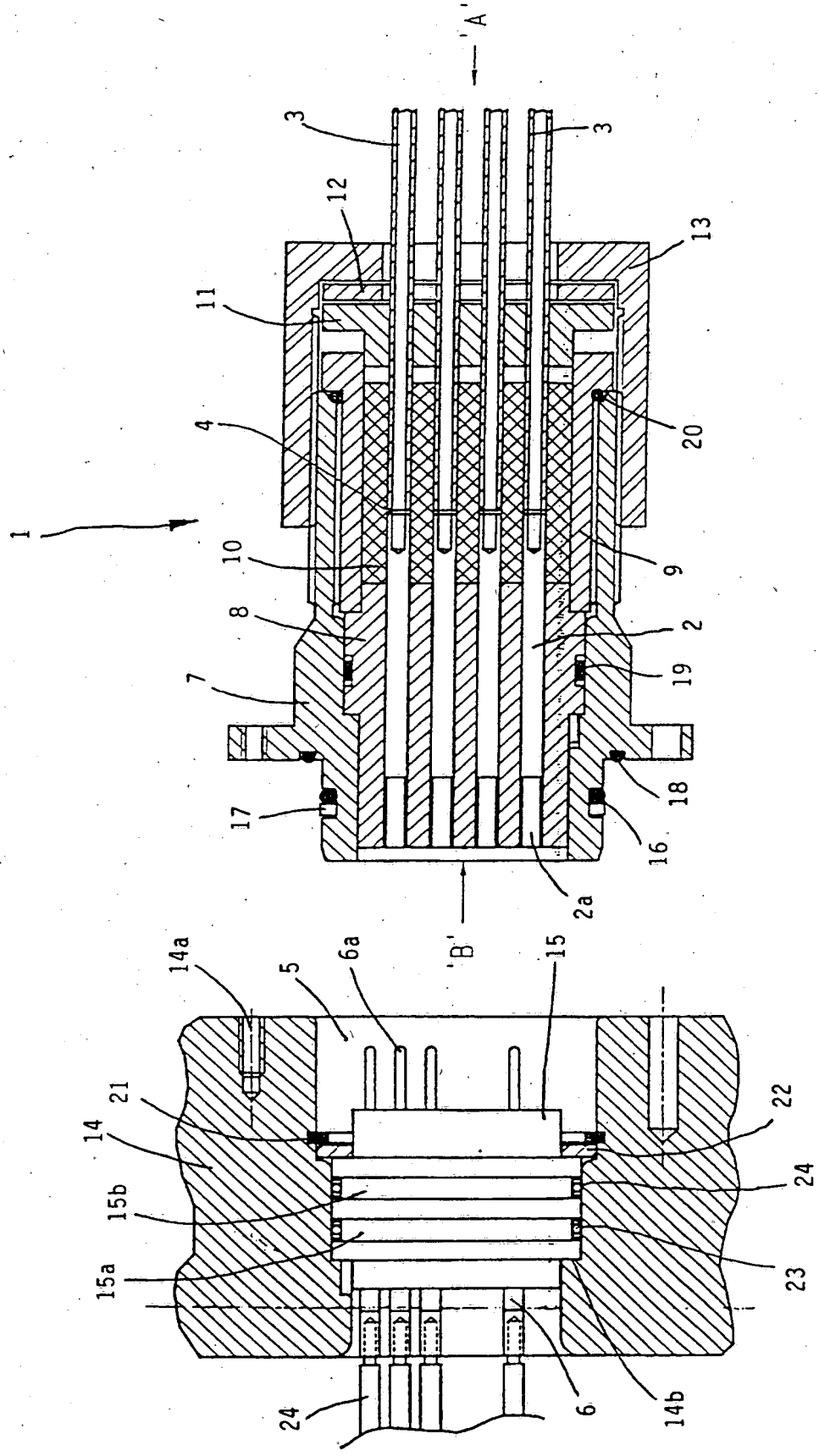
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'B'
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2
2a
3
4
5
6
6a
7
8
9
10
11
12
13
14
14a
14b
15
15a
15b
16
17
18
19
20
21
22
23
24

FIGURE 1.

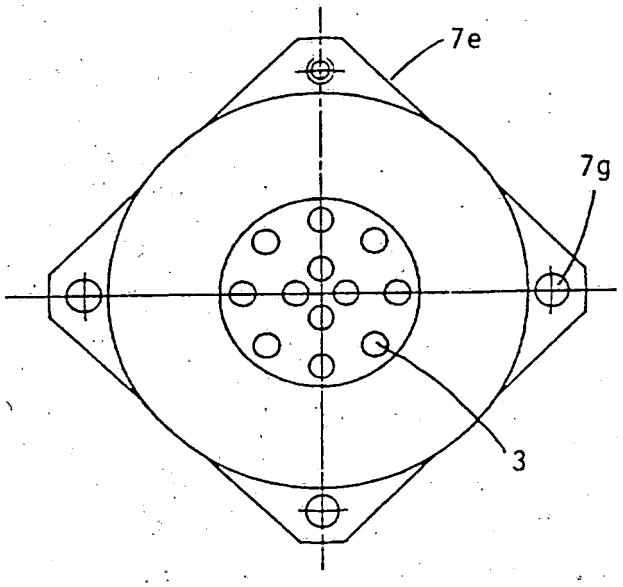

FIGURE 2.

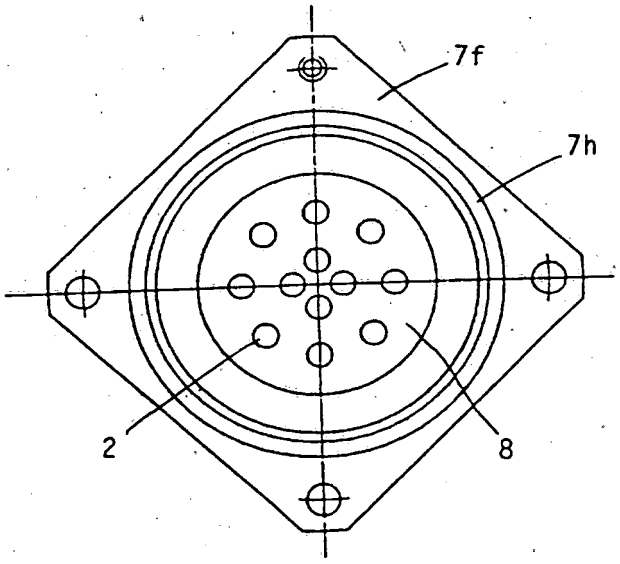

FIGURE 3.

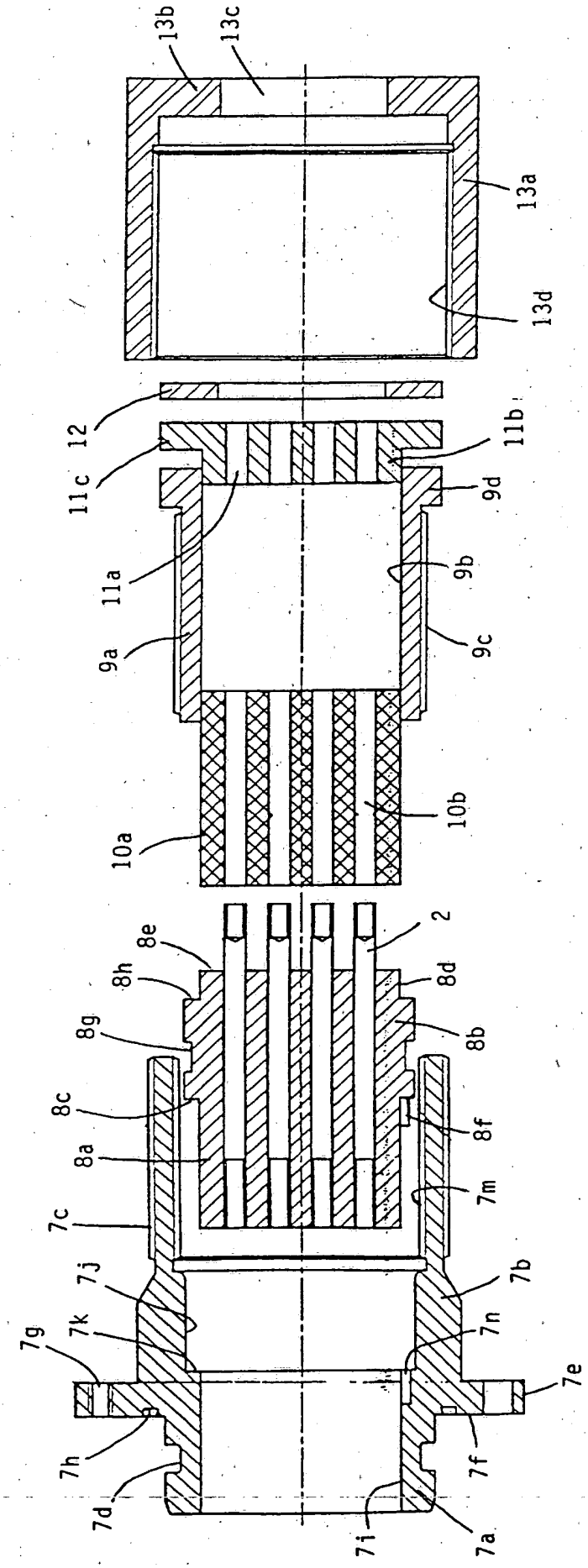
13b
13c
13a
13d
12
11c
11b
9d
11a
9b
9a
9c
10a
10b
2
8e
8h
8d
8g
8b
8c
8f
8a
7m
7c
7j
7b
7g
7k
7n
7e
7h
7f
7d
7i
7a

FIGURE 4.

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IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONNECTORS

This invention concerns improvements in or relating to electrical connectors.

The invention has particular application to electrical connectors for making electrical connections between individual cores of multi-core cables in adverse environments, for example underwater, by means of co-operating male and female parts, for example a plug and socket, having separate mating contacts for connection to individual cable cores.

It is already known to provide protection against water ingress by overmoulding onto the outer insulation of the individual cable cores and/or by overmoulding onto the outer insulation of the cable and the associated connector body. In the latter case, the integrity of the connector is only as good as the integrity of the outer insulation of the cable. Such overmoulding is process dependent limiting its application to certain insulation materials such as polyurethane and is non-repairable.

It is an object of the present invention to provide an improved electrical connector in which the drawbacks of overmoulding can be avoided in a simple and effective manner.

According to the present invention we provide an electrical connector comprising a plurality of electrical contacts for connection to individual conductor cores within respective through bores of a resilient sealing means, and compression means for axially compressing the sealing means to seal around each contact and the associated conductor core.

Preferably, the compression means is arranged to compress the sealing means by threaded engagement of first and second parts of the connector.

Advantageously, the compression means has a plurality of through holes aligned with the through bores for passage of the conductor cores with the compression means being urged axially by threaded engagement of the first and second parts to compress the sealing means.

In a preferred arrangement, the first part comprises a hollow body in which the sealing means is mounted and the second part comprises a nut arranged to urge the compression means axially by threaded engagement with the hollow body.

Advantageously, axial movement of the compression means is controlled to limit the compression of the sealing means. For example, the hollow body may be provided with an end stop to limit axial movement of the

Preferably, the contacts are mounted in an insert axially located in the hollow body and the sealing means is arranged to be compressed between the insert and the compression means.

In a preferred arrangement, the end stop is provided by a lock ring threadably engageable with the hollow body to locate and retain the insert against a shoulder within the hollow body, and the sealing means is conveniently arranged to be compressed between the insert and the compression means within the lock ring.

Advantageously, the compression means is a sliding fit in the lock ring to compress the sealing means on tightening the compression nut and is arranged to engage the lock ring to limit compression of the sealing means.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings wherein:-

FIGURE 1 is a longitudinal section through an electrical connector embodying the invention;

FIGURE 2 is a view in the direction of arrow A in Figure 1;

FIGURE 3 is a view in the direction of arrow B in Figure 1; and

FIGURE 4 is an exploded section view of the component parts of the plug shown in Figure 1.

Referring to the accompanying drawings, a plug 1 of a plug and socket type electrical connector is shown comprising a plurality of plug contacts 2 connected to individual conductor cores 3 of a multi-core cable by respective solder joints 4.

The plug 1 is arranged for push-fit connection to a socket 5 in a predetermined fixed orientation aligning the plug contacts 2 for engagement with mating socket contacts 6 when the connector is assembled.

In this embodiment, the plug contacts 2 have blind holes 2a arranged to receive mating pins 6a of the socket contacts 6 but it will be understood that other types of mating contacts may be used.

The component parts of the plug 1 comprise a plug body 7, a contact insert 8, a lock ring 9, a seal 10, a compression plate 11, a thrust washer 12 and a compression nut 13. The component parts of the socket 5 comprise a socket body 14 and a contact insert 15.

The plug body 7 has a front end 7a for push-fit reception in the socket 5 when the connector is assembled and a rear end 7b provided with an external screw thread 7c for threaded engagement with the compression nut 13 when the plug 1 is assembled.

An O-ring seal 16 and PTFE ring 17 seated in an annular groove 7d in the front end 7a provide a fluid-tight seal between the front end 7a of the plug 1 and the socket 5 when the connector is assembled.

Between the front and rear ends 7a,7b there is a flatted flange 7e of square cross-section for gripping the plug body 7 with a spanner or like tool and providing an abutment face 7f for the socket body 14 when the connector is assembled.

The flange 7e is provided with a respective aperture 7g in each corner for registration with holes 14a in the socket body 14 when the connector is assembled. One hole 14a receives a dowel pin (not shown) to locate the plug 1 and socket 5 in the required orientation and the other holes 14a are tapped for engagement of threaded fasteners (not shown) to secure releasably the plug 1 and socket 5 together preventing accidental separation.

An O-ring seal 18 seated in an annular groove 7h in the abutment face 7f provides a fluid-tight seal between the flange 7e and the socket body 14 when the connector is assembled.

The plug body 7 has a cylindrical bore 7i at the front end 7a and a coaxial counterbore 7j at the rear end 7b terminating in a shoulder 7k for locating the contact insert 8 when the plug 1 is assembled.

The counterbore 7j is provided with an internal screw thread 7m at the outer end for threaded engagement of the lock ring 9 to retain the contact insert 8 when the plug 1 is assembled.

The contact insert 8 mounts the plug contacts 2 in spaced parallel relationship to each other and is made of insulating non-conducting material to isolate the contacts 2 from each other.

The insert 8 has a cylindrical front end 8a and a coaxial rear end 8b of larger diameter with a shoulder 8c at the interface and a peripheral recess 8d in rear end face 8e.

The insert 8 is a sliding fit in the plug body 7 when the plug 1 is assembled to position the front end 8a in the bore 7i and the rear end 8b in the counterbore 7j with the shoulder 8c seated against the shoulder 7k.

The insert 8 has an axial rib 8f extending from the shoulder 8c and the plug body 7 has a complementary axial groove 7n in which the rib 8f is received to locate the insert 8 in the required angular orientation and prevent rotation of the insert 8 within the plug body 7 when the plug 1 is assembled.

An O-ring seal 19 seated in an annular groove 8g in the rear end 8c provides a fluid-tight seal between the insert 8 and the plug body 7 when the plug 1 is assembled.

The lock ring 9 has a sleeve 9a with a cylindrical bore 9b and an external screw thread 9c that extends from a flange 9d at one end for threaded engagement with the screw thread 7m in the counterbore 7j when the plug 1 is assembled.

The other end of the sleeve 9a is received in the recess 8d and engages a shoulder 8h to locate and retain the insert 8 against the shoulder 7k when the plug 1 is assembled with the flange 9d seated against radial end face 7p of the plug body 7 to prevent overtightening of the lock ring 9.

An O-ring seal 20 seated on the sleeve 9a against the flange 9d provides a fluid-tight seal between the lock ring 9 and the plug body 7 when the plug 1 is assembled.

The seal 10 has a cylindrical body 10a made of a elastomeric or resilient material such as neoprene or silicone with a plurality of through bores 10b arranged in spaced parallel relationship corresponding to the plug contacts 2.

The plug contacts 2 extend from the rear end face 8e of the insert 8 and are connected to the conductor cores 3 within aligned bores 10b of the seal 10 so that the solder joints 4 are isolated from each other when the plug 1 is assembled.

The compression nut 13 has a flatted body 13a for engagement by a spanner or like tool with the compression plate 11 and thrust washer 12 arranged to be seated in the body 13a against an inward lip 13b bounding an aperture 13c at one end for passage of the conductor cores 3.

The other end of the nut 13 has an internal screw thread 13d for threaded engagement with the external screw thread 7c of the plug body 7 when the plug 1 is assembled.

The compression plate 11 has a plurality of through holes 11a aligned with the through bores 10b in the seal body 10a for passage of the individual conductor cores 3 when the plug 1 is assembled.

A front portion 11b of the compression plate 11 is a sliding fit in the bore 9b of the lock ring 9 until a rear end portion 11c of larger diameter abuts the flange 9d at the end of the lock ring 9 when the plug 1 is

Assembly of the plug 1 will now be described. The end of the cable is prepared by removing the outer insulation together with any reinforcement and packing material to expose and separate the required length of individual conductor cores 3.

The compression nut 13 and thrust washer 12 are slid over the cores 3 which are then separately fed through the apertures 11a of the compression plate 11 and the bores 10b of the seal 10.

The lock ring 9 is next slid over the seal 10 and the individual conductor cores 3 soldered to the plug contacts 2 of the insert 8. The insert 8 is then positioned in the plug body 7 and the lock ring 9 screwed into the plug body 9 to axially locate and retain the insert 8 therein.

The seal 10 is then butted against the insert 8 within the lock ring 9 and the compression plate 11 slid over the conductor cores 3 to butt the front portion 11b against the seal 10 leaving an axial clearance gap between the rear portion 11c and the lock ring 9.

The compression nut 13 is next screwed onto the plug body 7 and tightened causing axial movement of the compression plate 11 to compress the seal 10 until the rear portion 11c engages the lock ring 9.

The compression of the seal 10 creates a water block seal around the solder joints 4 and with the rear end face 8e of the insert 8 and with the bore 9b of the lock ring 9.

As previously mentioned, the assembled plug 1 is arranged for push fit connection of the plug contacts 2 with mating contacts 6 of the socket 5.

The contact insert 15 mounts the socket contacts 6 in spaced parallel relationship to each other and is made of insulating non-conducting material to isolate the contacts 6 from each other.

The socket insert 15 is a sliding fit in the socket body 14 and is located on a shoulder 14b in the required orientation by engagement of co-operating formations preventing rotation of the socket insert 15 in similar manner to the plug insert 8.

The insert 15 is secured in the socket 5 by a circlip 21 with a washer 22 therebetween and a pair of O-rings 23,24 located in annular grooves 15a,15b respectively provide a fluid-tight seal between the insert 15 and the socket body 14.

The socket contacts 6 are connected to individual conductor cores 24 and these connections may be sealed within a compressible multi-bore seal in similar manner to the above-described connections within the plug 1

As will be understood, the invented arrangement of sealing the electrical connections within separate bores of a compressible multi-bore seal isolates all other conductor cores if individual core insulation is cut or damaged and isolates all contacts if the outer sheath of the multi-core cable is cut or damaged.

In addition, the invented arrangement provides a mechanical seal of simple construction which can be assembled in situ and which can be taken apart and re-assembled for repair with guaranteed repeatable uniform sealing pressure provided by the controlled axial movement of the compression plate.

Furthermore, axial movement of the compression plate can be set to provide any required compression of the seal by adjusting the axial clearance gap obtained when the compression plate is butted against the seal during assembly.

It will be understood that the invention is not limited to the embodiment above-described. For example, any number of contacts may be provided and these may be arranged in any desired pattern according to the required electrical connections for a given application.

Other variations and alternatives to the above-described embodiment will be apparent to those skilled in the art and the

Claims:

1. An electrical connector comprising a plurality of electrical contacts for connection to individual conductor cores within respective through bores of a resilient sealing means, and compression means for axially compressing the sealing means to seal around each contact and the associated conductor core.

2. A connector according to Claim 1 wherein the compression means is arranged to compress the sealing means by threaded engagement of first and second parts of the connector.

3. A connector according to Claim 2 wherein the compression means has a plurality of through holes aligned with the through bores for passage of the conductor cores with the compression means being urged axially by threaded engagement of the first and second parts to compress the sealing means.

4. A connector according to Claim 2 or Claim 3 wherein the first part comprises a hollow body in which the sealing means is mounted and the second part comprises a compression nut arranged to urge the compression means axially by threaded engagement with the hollow body.

5. A connector according to Claim 4 wherein axial movement of the compression means is controlled to limit the compression of the sealing means.

6. A connector according to Claim 5 wherein the hollow body is provided with an end stop to limit axial movement of the compression means when the compression nut is tightened.

7. A connector according to any one of Claims 4 to 6 wherein the contacts are mounted in an insert axially located in the hollow body and the sealing means is arranged to be compressed between the insert and the compression means.

8. A connector according to Claim 7 as dependent on Claim 6 wherein the end stop is provided by a lock ring threadably engageable with the hollow body to locate and retain the insert against a shoulder within the hollow body.

9. A connector according to Claim 8 wherein the sealing means is arranged to be compressed between the insert and the compression means within the lock ring.

10. A connector according to Claim 9 wherein the compression means is a sliding fit in the lock ring to compress the sealing means on tightening the

11. A connector according to any one of the preceding Claims comprising a plug adapted for push fit connection to a socket with the plug contacts arranged for engagement with mating socket contacts.

12. An electrical connector substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office

9

Application No: GB 9707071.8 **Examiner:** E. QUIRK
Claims searched: 1-12 **Date of search:** 16 May 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H2E(EEPG, EFBE, EGEA)

Int Cl (Ed.6): H01R

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2 130 026 A (Precision Mechanique)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than the filing date of this application.